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# Feed and Scavenge Pump Arrangement

The invention to which this application relates is to the provision of a feed and scavenge pump arrangement for use in pumping apparatus generally but typically, as oil pumps for use in engines such as those, but not necessarily exclusively, used in motor cycles.

The provision of feed and scavenge pump arrangements is known and, for example, the applicant's own patent application, GB2178110A discloses one such arrangement.

The pump arrangement is provided to, when used for oil purposes, perform two functions, a feed pump arrangement being provided to allow the provision of lubricating oil to crank shaft bearings of the engine and the scavenging pump allowing the scavenging or removal of oil from the engine sump. Both the feed and scavenge pump components are connected to an oil reservoir from which the oil is pumped and returned by respective pumps. Thus, in use, the feed pump draws oil from the oil reservoir and feeds the same to the crankshaft whilst the scavenge pump draws oil from the sump and returns it to the reservoir such that, in combination, there is always sufficient oil passing throughout the system to allow the feed and scavenge pumps to operate, and the components of the engine to be fed with oil as required.

Various problems have been encountered with feed and scavenge pump arrangements of the type described and while various improvements have been suggested and implemented to meet and indeed overcome the specific problems, problems are still experienced in the operation of the feed and scavenge pump arrangements. One problem is that, in operation, the scavenge

pump is required to overcome the actions of the feed pump and this can cause problems.

Another particular problem is that the components of the arrangement can be difficult to manufacture and this in turn can add to the expense of the components to the customer and/or the motor cycle manufacturer.

Another problem is that in the operation of the pumps, the tolerances required to be provided between the pump teeth and the pump chamber walls between which the oil is moved in the pumped manner are relatively tight which again can make manufacture difficult.

The aim of the present invention is to provide an improved feed pump and scavenging pump arrangement and components for the same in an improved manner which allows an increase in efficiency of operation of the pump and also, at the same time, improved ease of manufacture of the components.

In a first aspect of the invention there is provided apparatus for the movement of fluid, said apparatus including a feed pump and scavenge pump for use in conjunction with a reservoir which liquid is moved to and from by the feed pump and scavenge pump said pumps each include inner and outer rotary pump members housed in respective pump chambers in a body portion, with said inner rotary pump members mounted for rotation by a driveshaft; said body portion including formed therein, inlet and outlet bores in connection with respective feed and scavenge pump chambers, said bores formed in the body to allow connection with a crankshaft and reservoir for the feed pump and a sump and reservoir for the scavenging pump, and characterised in that each of said bores are provided with a first

end opening on a first side of the body and an opposing end terminating at a respective pump chamber.

Typically the bores are provided with a first end opening on the underside of the body and an opposing end terminating at a respective pump chamber surface lying in a plane substantially perpendicular to the axis of rotation of the driveshaft for the inner rotary pump members.

Typically, the four bores formed in the body curve with respect to at least two of, but more typically the three, XYZ axes.

In one embodiment, the body of the arrangement is metal and formed by casting.

Typically, each of the pumps comprise a pumping chamber with an outer rotary pump member and an inner rotary pump member, said inner rotary pumping member mounted eccentrically with respect to the outer rotary pump member and mounted for rotation on a driveshaft. Typically the outer rotary pumping member in each pump arrangement is mounted to be driven by the inner rotary member. Typically the driveshaft is common to both inner rotary pumping elements.

In one embodiment, said drive shaft is controlled by a gearbox to rotate in forward and reverse directions for predetermined periods of time therefore allowing staggered operation of the respective feed and scavenge pumps in an episoidal manner.

Typically the pump arrangement is provided to be retrofitted as replacement components to an existing engine, typically that of a motor cycle and, as a result, certain fixing locations are required to be maintained in the standard positions. The bores are therefore formed in the body so as to avoid conflict with the

fixing locations within the body portion. In addition to the bores avoiding conflict with the fixing locations, the openings for the bores from the body are also provided to be at locations to allow connection with the conventional connections with the crankshaft, sump and oil reservoir ports as required.

Typically the components of the arrangement, are sintered and heat treated as required to ensure that the same have the required wear characteristics.

In a further aspect of the invention there is provided a A feed pump for removing liquid and a scavenge pump for introducing liquid from and to an oil reservoir of an engine, said feed and scavenge pumps including inner and outer rotary pump members housed in respective pump chambers in a body portion, said inner rotary pump members each mounted on a common driveshaft and said body portion including formed therein, inlet and outlet bores in connection with respective feed and scavenge pump chambers, said bores formed in the body to allow connection with the crankshaft and reservoir for the feed pump chamber and a sump and reservoir for the scavenging pump chamber and characterised in that each of said bores are provided with a first end opening on a first side of the body and an opposing end terminating at a respective pump chamber surface lying in a plane substantially perpendicular to the axis of rotation of the driveshaft of the inner rotary pump members.

Specific embodiments of the invention are now described with respect to the accompanying figures; wherein

Figure 1 illustrates the various components of an embodiment of the invention and the manner in which the components interlink to form the pump arrangement;

Figure 2 illustrates an elevation of the components of Figure 1 in an engaged format;

Figures 3a –e illustrate various views of an embodiment of the pump body; and

Figure 4 illustrates an elevation of the gear box housing.

Referring firstly to Figure 1 there is illustrated the components of a pump arrangement according to one embodiment of the invention. The components comprise a body portion 2 which receives therein a drive shaft 4. The drive shaft has a first end on which a gear wheel 6 is mounted in engagement with a gear assembly 9 provided in a port 11 in housing 8, shown in Figure 4 which is connected to the body via plate 10. Provided between the plate 10 and body 2, in a pump chamber 28 are outer and inner rotary pump members 14,16 for the feed pump. At the opposing end of the body 2, outer and inner rotary pump members 18,20 form, in conjunction with a chamber 39 in the body and the end plate 22, the scavenge pump arrangement.

Figure 2 illustrates a typical arrangement of the components when brought in to position for use with respect to the sump, engine crankshaft and oil reservoir, shown generally as reference numeral 24 as these components are provided in the conventional form. What is not shown in Figure 2 is the detail of the internal features of the body 2 and these are shown in Figures 3a-e.

Turning firstly to Figure 3e there is shown an end face 26 of the body 2 with a feed pump chamber 28 and aperture 30 through which the drive shaft 4 passes. The inner and outer rotary pump members 14, 16 lie in the pump chamber 28. Also illustrated are the openings for two bores 32,34 with the other

ends of these bores located on the underside 36 of the body and indicated by the numerals 32',34' respectively.

The bores 32, 34 are provided to allow, as these are for the feed pump arrangement, the passage of oil through a first bore from the oil reservoir into the pump chamber 28 and then to be pumped by movement of the inner and outer rotary members 14, 16 in the chamber 28 through the other of the bores to lubricate the engine crankshaft.

With reference to the Figures 3a-d the various views illustrate the internal paths of the bores 32,34 for the feed pump arrangement and also the paths of the bores 38,40 for the scavenge pump arrangement from the pump chamber 39 to the openings 38', 40' illustrated on the underside 36 of the body. In the scavenge pump arrangement the rotary pump members achieve the recovery of oil through a first one of the bores 38,40 from the engine sump with which the bore is connected, into the chamber 39, and then from the chamber by rotation of the inner and outer rotary members 28, 20, through the other of the bores 38,40 to the oil reservoir for subsequent use.

Thus, in use, the gear assembly 9 is controlled to rotate the drive shaft 4. The inner rotary pump members 16 and 20 of the feed and scavenging pumps respectively, are mounted on the drive shaft at respective ends of the body 2 so as to be driven to rotate by the drive shaft in their respective chambers 28,39. The inner rotary members are eccentrically mounted with respect to their respective outer rotary members 14, 18 and the engagement of the protrusions 51 on the same as shown in Figure 3c ensures that the outer rotary members are also driven to rotate and the pumping of the oil is achieved in the gap between the inner and outer rotary members as they rotate. The relative movement between the protrusions of the inner and outer rotary members

creates the pumping action in the respective chambers and hence the passage of the oil through the bores. In addition the drive shaft 4 is driven by the gear shaft 9 to move in forward and reverse rotational directions in an episoidal manner thereby allowing the feed and scavenging pumps to operate in successive periods. This therefore means that there is no need for a gearing assembly to be provided for either of the feed pump or scavenging pump in the body 2 and therefore overcomes problems with the conventional wear of the gear components while at the same time improving the functionality of the arrangement.

In addition the shaping and passage of each of the bores in the body 2 is such as to allow the conventional location formations to be maintained as well as the location of the bores on the underside 36 of the body thereby allowing the arrangement of this invention to be retrofitted to existing engines which is an important market. In order to allow efficient operation of the pumps, the bores are provided to enter the pump chamber on the surfaces 53, 55 which are substantially perpendicular to the axis of rotation 57 of the driveshaft and which are the surfaces on which the aperture 30 is formed so as to allow the end feeding of the oil into and from the chambers 28, 39 which is in contrast to the conventional feeding of the oil from the side walls of the chamber. In order to achieve these requirements for the invention it will be appreciated that each of the bores is provided to curve with respect to at least two of the XY and Z axis but more typically all three axes as is illustrated in the accompanying figures.